

Situational Awareness in Acute Patient Deterioration

Identifying Student Time to Task

Anne White, PhD, RN, CNE; Mary Beth R. Maguire, DSN, RN, CNE, CHSE; Jane Brannan, EdD, RN, CNE; and Austin Brown, PhD

ABSTRACT

Background and Purpose: Prelicensure nursing students lack the situational awareness to promote timely intervention with a patient in septic shock. This study evaluated a multifaceted educational project that determined the impact on nursing students' knowledge retention and time to task (TTT).

Methods: A quasi-experimental, repeated-measures design was used to evaluate students' knowledge retention and TTT. Eighty-four prelicensure nursing students participated in groups of 4 students to participate in a high-fidelity simulation.

Results: Results show knowledge retention was significant between the pretest scores and 2 repeated assessment scores. The repeated-measures analysis of variance time effect *P* value was .02. The overall TTT group response suggested most (64/84, 76%) students responded within 5 minutes of patient deterioration.

Conclusions: A multifaceted approach was effective to influence knowledge of septic shock over time and demonstrate students' ability to intervene with a septic shock patient in a timely manner.

Keywords: acute deterioration, nursing student, sepsis, simulation, situational awareness, time to task

Cite this article as: White A, Maguire MB, Brannan J, Brown A. Situational awareness in acute patient deterioration: identifying student time to task. *Nurse Educ.* 2021;46(2):82-86. doi: 10.1097/NNE.0000000000000968

The United States has an annual estimate of 1.7 million adult sepsis cases each year, resulting in nearly 270 000 deaths.¹ Sepsis remains a significant public health challenge.² This medical emergency requires prompt recognition and response by clinicians to prevent patient deterioration^{3,4} and death.⁵

Studies address nursing students' knowledge and skill of timely recognition and intervention in real time with deteriorating patients experiencing life-threatening cardiac, respiratory, and/or shock emergencies.⁶⁻⁸ There is a gap in determining students' response times after initial signs of

patient deterioration and retention of knowledge in septic shock. Students' response times and knowledge retention have implications for transferring to actual patient care experiences.

Recognizing significant cues that may signal detrimental patient events and taking immediate action to prevent such events are critical skills for nurses. The ability to recognize deteriorating patients and intervene appropriately is a sign of strong clinical reasoning (CR).^{9,10} Studies identified many factors influencing nurses' assessment of patient acuity and response to acute deterioration.¹¹⁻¹⁴ Situational awareness (SA) is a concept that summarizes these integral factors. Three key concepts describe SA: perception of the situation, understanding the meaning of the perception, and rapidly predicting the outcome of the situation.¹⁵ Strengthening SA involves educational opportunities that incorporate these 3 concepts.

Regarding SA of septic shock, nurses must be able to perceive the clinical indicators and patient cues that suggest septicemia before septic shock occurs. Multiple studies suggest newly licensed RNs are adequately prepared with the theoretical knowledge yet lack the skill to manage rapid patient deterioration.^{6,7,16} High-fidelity simulation in prelicensure nursing programs provides a simulated learning environment that is an effective strategy to safely practice high-risk events such as a patient in septic shock.¹⁷

Author Affiliations: Professor (Drs White and Brannan) and Assistant Professor (Dr Maguire), WellStar School of Nursing, and Assistant Professor (Dr Brown), Department of Statistics and Analytical Sciences, Kennesaw State University, Georgia.

The authors declare no conflicts of interest.

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Correspondence: Dr White, WellStar School of Nursing, 520 Parliament Garden Way, Kennesaw, GA 30144 (awhite@kennesaw.edu).

Accepted for publication: November 23, 2020

Published ahead of print: January 16, 2021

DOI: 10.1097/NNE.0000000000000968

High-fidelity simulation offers students the opportunity to experience the care of a critical patient in a controlled environment. Carefully constructed scenarios offer opportunities for rehearsal of CR. Clinical reasoning comes through the perception of the event, understanding by way of the scenario and associated debrief, and an opportunity to predict how the simulated patient will respond to treatment given. Evidence suggests students' ability to identify physiological causes for patient deterioration increased using simulation.^{6,18,19} However, Cooper et al⁶ found the students' skill performance worsened as the patient's condition worsened. Multiple researchers report a nonsignificant correlation between students' knowledge and ability to improve their scenario performance.^{6,8,17} Repetitive practice improves performance.^{7,8,18,20,21} Therefore, educational activities that incorporate opportunities to increase perception and understanding, and predict how a patient in septic shock will respond to improve SA are worth pursuing.

The term *time to task* (TTT) was developed by Shinnick and Woo²² to perform specific nursing care activities within a specified period. Whereas there are no standard guidelines for intervening with patients in septic shock, there are guidelines for other urgent conditions such as stroke and cardiac arrest.^{23,24} These authors used a known group (expert vs novice) comparative design to compare TTT.^{22,25} An objective measure of completing nursing care activities within 5 minutes was compared with 2 subjective measures of students' performance. The results indicated that TTT had good sensitivity and specificity in differentiating between groups. Time to task also offers promise for objective clinical nursing evaluation and feedback.^{22,25}

There are no specific time limits established for nurses' recognition of patient deterioration and appropriately escalating patient care in septic patients. However, for nurses to follow the sepsis bundle guidelines,³ a rapid assessment and perception of the clinical emergency needs to occur within a few minutes of assuming care. Rapid identification is essential because getting help and implementing appropriate interventions require more time. Adhering to time guidelines during training could prove useful for nursing students to rehearse time-based interventions with septic shock patients.

This article reports the findings of a study examining prelicensure nursing students' SA in a simulated clinical setting related to TTT. The research questions were as follows: (1) "To what extent is knowledge gained and maintained in managing a septic shock patient?" and (2) "Is there a relationship between knowledge of septic shock and TTT?"

Theory

The learning experience for this study used the CR model.¹⁰ The model acknowledges the unique differences between novice and expert nurses' responses to deteriorating patients. Its premise is that effective CR requires nurses to collect an accurate assessment and respond with the right action (SA) appropriate for the right patient at the right time (TTT).¹⁰

Methods

Research Design

The study used a quasi-experimental, repeated-measures design. Eighty-four senior baccalaureate nursing students participated as a component of a complex health care course and were randomly assigned to 21 groups of 4 students. Students engaged in a learning strategy to perceive, recognize, and predict the clinical emergency of a patient in septic shock. The event served as a formative opportunity to improve timely care to deteriorating patients without the threat of a high-stakes assessment or a graded performance. The university institutional review board approved the study.

Knowledge of septic shock was assessed using a set of multiple-choice questions about sepsis. Participants completed a knowledge assessment before the educational event, after the educational event, and 3 months later. Participants were video recorded in the simulation suite, and the researchers used the recordings to determine TTT.

Instruments

The 2 instruments used were the Septic Shock Questionnaire (SSQ) to measure knowledge and the Student Action Observation Instrument (SAOI) to document TTT. Class enrollment statistics provided the demographic data of the participants. The SSQ was a 10-item, researcher-designed, multiple-choice format instrument to measure knowledge related to nursing management of a patient in septic shock. The tool content focused on key concepts identified in a review of the literature regarding sepsis and the implementation of evidence-based treatment protocols.^{3,26} The SSQ was administered online, with scores ranging from 0 to 10. Four expert nurse educators determined the SSQ content validity average of 0.94. Expert raters had 5 or more years of acute care nursing experience and 10 or more years of teaching advanced nursing at the baccalaureate level or higher. Cronbach's α of .22 was calculated for all items across all assessed time points. The instrument was used as a summative evaluation to quantify knowledge over time.

The research team created the SAOI and used it to document students' TTT. The instrument is a graphic form depicting the timeline of the scenario. Guided by the literature,^{22,25} investigators established 5 minutes as the TTT for this study. Researchers reviewed the simulation videos and recorded the time on the SAOI from the predetermined moment of deterioration (3 minutes into the scenario) to the student's notification of the rapid response team or physician. Once the deterioration began, student expectations included assessing the patient, identifying physiological manifestations of shock in the patient, and notifying the rapid response team or the physician within the designated 5 minutes. Groups that did not assess and notify the rapid response team or physician by the 5-minute mark (8 minutes into the scenario) received a score of 0. Teams that assessed and notified the rapid response team or physician by the 5-minute mark received a score of 1.

Procedure

The SSQ was administered online before the classroom content or the laboratory and simulation experience (SSQ1), immediately after completion of all components of the educational strategy (SSQ2), and at 3 months (SSQ3). All students (including those not participating in the research study) completed the SSQ1 and SSQ2 as part of the course procedure. Only participating students completed the knowledge assessment (SSQ3) 3 months later, to assess knowledge retention. Time to task was determined by evaluating participants' video recordings and documenting TTT on the SAOI.

Because of course enrollment, the class consisted of 2 groups: half went to the laboratory and simulation experience in week 1, whereas the other half attended the classroom presentation. The following week, the students' rotations were reversed. The teaching strategies included a 2-hour lecture with PowerPoint during the class session. The presentation included content on infections and sepsis, including early signs/symptoms of sepsis, evidence-based recommendations for treatment, and assessment strategies using sepsis protocol guidelines.

During the laboratory experience, students rotated through 2 stations about various aspects of septic shock. The stations were (1) a case study with clinical decision questions related to sepsis and (2) use of a standardized screening tool.³ During the case study station, the students worked in groups of 4 to answer clinical decision questions related to sepsis and septic shock. Faculty guided the students to ensure completion of the objectives. The assessment station involved interaction with a fixed-scenario, high-fidelity manikin to improve assessment and perception of sepsis deterioration.

The simulation scenario was designed by a certified simulation educator and incorporated simulation best practices.²⁷ The scenario was 20 minutes in length and depicted a 72-year-old male patient with a urinary tract infection. Three minutes into the scenario, the patient developed clinical manifestations consistent with septic shock. Vital signs were available via a dynamic monitor. No audible alarm alerted the students to changes in physiological parameters. Because of the scenario's planned deterioration, the patient's chart did not include provider orders for appropriate treatment of septic shock. The participants were expected to notify the physician to obtain orders.

A simulation algorithm established the simulation scenario's timeline and outcomes for specific pathways, ensuring replication of the simulation.²⁸ The timeline within the algorithm allowed researchers to measure TTT. The clinical manifestations of septic shock occurred 3 minutes into the scenario. Participants' expectations included assessing, identifying septic shock, and alerting either the physician or rapid response team within 5 minutes after deterioration. Scripts for manikin and physician verbal responses and prebriefing/debriefing guidelines for facilitators minimized faculty researcher improvisation and provided consistency between scenarios. A certified health care simulator

educator trained the facilitator of each simulation in debriefing techniques.²⁷

Data Analysis

A repeated-measures analysis of variance (RM-ANOVA) in SAS/STAT 14.1 (SAS Institute Inc, Cary, North Carolina) sought to answer the first research question related to knowledge gained and maintained. The SAS procedure used for analysis used a maximum likelihood approach instead of the ordinary least squares for estimation. The researchers used a correlational analysis in R version 4.0.2 (Vienna, Austria) to investigate the second research question concerning the relationship between the first posttest knowledge scores and TTT. A *P* value of less than .05 significance level was considered statistically significant.

Results

One hundred twenty-four students were invited to participate. Eighty-four students participated in the study, spring cohort (*n* = 55) and fall cohort (*n* = 29). Ages ranged from 26 to 53 years (mean [SD], 23 [7.4] years), with 89% (*n* = 75/84) female and 11% (*n* = 9/84) male.

In response to research question 1, "To what extent is knowledge gained and maintained in managing a septic shock patient?", no statistically significant difference in mean scores was found between the fall (mean [SD], 5.85 [1.11]) and spring (mean [SD], 5.59 [1.44]) semesters. A significant difference was found between the pretest scores (mean [SD], 5.24 [1.41]) and first posttest scores (mean [SD], 6.15 [1.10]). This change reflects the educational intervention. The difference between the pretest and second posttest scores (mean [SD], 5.83 [1.10]) reflects knowledge retention over time.

It is important to note that the spring semester cohort was not given a second posttest because of the students' unavailability during the summer semester. Another essential point is that, in both the fall and spring cohorts, not all students were able to attend the lecture regarding septic shock before participating in the simulation because of practical considerations. As shown in the Table, the simulation order effect denotes the order in which a student received the simulation, either before lecture or post lecture. Simulation order effect was not found to be statistically significant.

In response to research question 2, "Is there a relationship between knowledge of septic shock and TTT?", the strongest correlation of students' knowledge and TTT was

Table. RM-ANOVA Table Comparing Knowledge Score Across Time and Semester

Effect	F Statistic	P
Semester effect	0.15	.70
Time point effect	4.49	.02
Simulation order effect	0.62	.44

observed was in the fall cohort ($r = 0.31$) compared with the spring cohort ($r = -0.08$). Although not statistically significant, likely due to the small sample size of the cohorts (fall, 29/84), this value has an intuitive interpretation. As knowledge scores increased, so too did the likelihood of the students' successful notification of the rapid response team or physician of septic shock within 5 minutes of decline. The overall TTT completion percentage indicated that most (64/84, 76%) of the groups of students responded within 5 minutes.

Discussion

The first question was related to the knowledge gained and retained 3 months after a septic shock educational event as measured by pre- and post-SSQ scores. No significant differences were found among groups regardless of the semester enrolled or the order of their lecture versus laboratory/simulation experience. Perhaps future course offerings could use a prerecorded lecture, so all students had the same information before the simulation. There were significant results, as evidenced by the time point effect (Table), between their initial SSQ, the first posttest, and the 3-month postsimulation mark. This finding suggests a combination of simulation and faculty-led debrief was meaningful and resulted in improved knowledge and retention over time. The introduction and practice of sepsis protocols that delineate nursing actions, which novice nurses may not be aware of, improved knowledge. This improved knowledge is the first step in developing SA.²⁹

Although retention of knowledge over 3 months is essential, a test of cognitive ability through an examination does not provide evidence that a new nurse can recognize events in a patient care environment. Previous studies found nursing students were inadequately prepared to manage a deteriorating patient in a clinical setting.^{6,7,17,20} However, exposure to patient deterioration simulations increased students' knowledge and ability to identify changes in patients' condition.^{6,17-19} This study supports the use of simulation as a means to impart knowledge over time.

Research question 2 sought to establish a relationship between knowledge of septic shock and TTT of a patient in septic shock. Although there was no significant correlation found, the study findings suggest a positive relationship between participants' knowledge and the ability to recognize and respond to a patient in septic shock. These results are similar to other studies that found a nonsignificant correlation between knowledge and skill performance.^{6,8,17} However, most (64/84, 76%) of the groups responded within 5 minutes of the initial stages of patient deterioration, indicating their recognition of the patient's decline.

The connection between perception, understanding, and prediction, critical components of SA, is supported by the results. Participants who understood septic shock were able to recognize (perceive) the signs and symptoms, predict the urgency of the situation, and intervene promptly. In addition, the study results support the CR conceptual model. Participants who were knowledgeable of septic shock were

able to collect assessment information during the simulation and appropriately respond within an adequate timeframe. This study highlights the need for nursing education to develop time-based goals in simulation training to improve the care of deteriorating patients.^{22,25}

Limitations

The researchers identified several limitations of the study. First, a small sample size makes the generalization of findings difficult. Repeating the study across multiple schools of nursing would provide a greater representation of the population. Second, a small sample size also makes statistical significance challenging to achieve. Third, only 1 simulation experience was available to participants. Providing an additional simulation experience concurrent with the repeated knowledge assessment would reveal whether SA and CR skills remained constant over time. Fourth, the reliability of the SSQ demonstrated a relative low value of α . This may be because 2 of the original 12 items of the SSQ were omitted after content validity was established by content experts. As a result, it was not feasible to assess reliability at the individual construct level and instead was assessed at the instrument level. Future studies should seek to establish construct validity of the SSQ.

Conclusion

The findings support providing educational opportunities that incorporate conventional means of disseminating knowledge (traditional class) and occasions to practice assessment, interpretation, and action related to septic shock under faculty supervision (laboratory and simulation experiences). Such learning activities can yield positive results in advancing both SA and CR.

Nurses must be better prepared to handle this life-threatening emergency to lower sepsis mortality rates. Improved SA and CR are skills that can result in early recognition and improved outcomes. However, these skills are complex. The skills require addressing teaching and learning from multiple dimensions. Innovative teaching and learning strategies that focus on improving SA and CR could better prepare the frontline nurses whose recognition and early action could save lives.

References

1. Centers for Disease Control and Prevention. Data and reports: sepsis. Available at <https://www.cdc.gov/sepsis/data/reports/index.html>. Accessed June 30, 2020.
2. Dantes RB, Epstein L. Combatting sepsis: a public health perspective. *Clin Infect Dis*. 2018;67(8):1300-1302. doi:<https://doi.org/10.1093/cid/ciy342>.
3. Levy MM, Evans LE, Rhodes A. The surviving sepsis campaign bundle: 2018 update. *Crit Care Med*. 2018;46(6):997-1000. doi:10.1097/CCM.0000000000003119.
4. Massey D, Chaboyer W, Anderson V. What factors influence ward nurses' recognition of and response to patient deterioration? An integrative review of the literature. *Nurs Open*. 2017;4(1):6-23. doi:10.1002/nop2.53.
5. Johnston ANB, Park J, Doi SA, et al. Effect of immediate administration of antibiotics in patients with sepsis in tertiary care: a systematic

- review and meta-analysis. *Clin Ther.* 2017;39(1):190-202.e6. doi:10.1016/j.clinthera.2016.12.003.
6. Cooper S, Kinsman L, Buykx P, McConnell-Henry T, Endacott R, Scholes J. Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness. *J Clin Nurs.* 2010;19(15-16):2309-2318. doi:doi.org/10.1111/j.1365-2702.2009.03164.x.
 7. Bogossian F, Cooper S, Cant R, et al. Undergraduate nursing students' performance in recognizing and responding to sudden patient deterioration in high psychological fidelity simulation environments: an Australian multi-center study. *Nurse Educ Today.* 2014;34(5):687-693. doi:10.1016/j.nedt.2013.09.015.
 8. Sapiano AB, Sammut R, Trapani J. The effectiveness of virtual simulation in improving student nurses' knowledge and performance during patient deterioration: a pre and post test design. *Nurse Educ Today.* 2018;62:128-133. doi:https://doi.org/10.1016/j.nedt.2017.12.025.
 9. Benner P, Sutphen M, Leonard V, Day L. *Educating Nurses: A Call for Radical Transformation.* Jossey-Bass; 2010.
 10. Levett-Jones T, Hoffman K, Dempsey J, et al. The 'five rights' of clinical reasoning: an educational model to enhance nursing students' ability to identify and manage clinically 'at risk' patients. *Nurse Educ Today.* 2010;30(6):515-520. doi:doi.org/10.1016/j.nedt.2009.10.020.
 11. Allen G. Barriers to non-critical care nurses identifying and responding to early signs of clinical deterioration in acute care facilities. *Med Surg Nurs.* 2020;29(1):43-52. Available at <http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=rzh&AN=141657275&site=eds-live&scope=site&custid=ken1>. Accessed November 3, 2020.
 12. Connell CJ, Endacott R, Jackman JA, Kiprillis NR, Sparkes LM, Cooper SJ. The effectiveness of education in the recognition and management of deteriorating patients: a systematic review. *Nurse Educ Today.* 2016;44:133-145. <https://dx.doi.org/10.1016/j.nedt.2016.06.001>.
 13. Dalton M, Harrison J, Malin A, Leavey C. Factors that influence nurses' assessment of patient acuity and response to acute deterioration. *Br J Nurs.* 2018;27(4):212-218. doi:10.12968/bjon.2018.27.4.212.
 14. Harley A, Johnston ANB, Denny KJ, Keijzers G, Crilly J, Massey D. Emergency nurses' knowledge and understanding of their role in recognising and responding to patients with sepsis: a qualitative study. *Int Emerg Nurs.* 2019;43:106-112. doi:doi.org/10.1016/j.ienj.2019.01.005.
 15. Fore AM, Sculli GL. A concept analysis of situational awareness in nursing. *J Adv Nurs.* 2013;69(12):2613-2621. doi:10.1111/jan.12130.
 16. Endacott R, Scholes J, Buykx P, Cooper S, Kinsman I, McConnell-Henry T. Final-year nursing students' ability to assess, detect and act on clinical cues of deterioration in a simulated environment. *J Adv Nurs.* 2010;66(12):2722-2731. <http://dx.doi.org/10.1111/j.1365-2648.2010.05417.x>.
 17. Cant RP, Cooper SJ. Use of simulation-based learning in undergraduate nurse education: an umbrella systematic review. *Nurse Educ Today.* 2017;49:63-71. doi:10.1016/j.nedt.2016.11.015.
 18. Cooper S, Porter J, Peach L. Measuring situation awareness in emergency settings: a systematic review of tools and outcomes. *Open Access Emerg Med.* 2013;6:1-7. doi:10.2147/OAEM.S53679.
 19. McKenna L, Missen K, Cooper S, Bogossian F, Bucknall T, Cant R. Situation awareness in undergraduate nursing students managing simulated patient deterioration. *Nurse Educ Today.* 2014;34(6):e27-e31. doi:https://doi.org/10.1016/j.nedt.2013.12.013.
 20. Abellsson A, Lindwall L, Suserud B, Rystedt I. Effect of repeated simulation on the quality of trauma care. *Clin Simul Nurs.* 2017;13:601-608. doi:10.1016/j.ecns.2017.07.006.
 21. Dzioba J, Cant R, Cooper S, Bogossian F, Phillips N. Barriers and enablers to learning during team-based clinical simulations: reflective interview with final year undergraduate nursing students. *J Nurs Educ Pract.* 2014;4(10):32-39. doi:https://doi.org/10.5430/jnep.v4n10p32.
 22. Shinnick MA, Woo MA. Validation of time to task performance assessment method in simulation: a comparative design study. *Nurse Educ Today.* 2018;64:108-114. doi:10.1016/j.nedt.2018.02.011.
 23. American Heart Association/American Stroke Association. Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals. Available at <https://www.ahajournals.org/doi/full/10.1161/str.000000000000158>. Accessed November 3, 2020.
 24. American Heart Association. American Heart Association guidelines for CPR and ECC. Available at <https://cpr.heart.org/en/resuscitation-science/cpr-and-ecc-guidelines>. Accessed November 3, 2020.
 25. Shinnick MA. Time-to-task validation in sequential simulations as a component of nursing student competency [published online ahead of print July 10, 2020, 1538-9855]. *Nurse Educ.* 2020. <https://doi.org/10.1097/NNE.0000000000000898>.
 26. Makic MBF, Bridges E. CE: managing sepsis and septic shock: current guidelines and definitions. *Am J Nurs.* 2018;118(2):34-39. doi:https://doi.org/10.1097/01.NAJ.0000530223.33211.f5.
 27. INACSL Standards Committee. INACSL standards of best practice: SimulationSM simulation design. *Clin Simul Nurs.* 2016;12:S5-S12. doi:10.1016/j.ecns.2016.09.005.
 28. Bartlett JL. A simulation template for a new simulation program. *Clin Simul Nurs.* 2015;11:479-481. <http://dx.doi.org/10.1016/j.ecns.2015.09.003>.
 29. Proffitt RD, Hooper G. Evaluation of the (qSOFA) tool in the emergency department setting: nurse perception and the impact on patient care. *Adv Emerg Nurs J.* 2020;42(1):54-62. doi:10.1097/TME.0000000000000281.